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TI - METHOD AND DEVICE FOR DETECTING DEFECT IN SUBSTRATE

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PA - ADVANTEST CORP;NIWANO MICHIO

IN - YOSHIDA HARUO;NIWANO MICHIO

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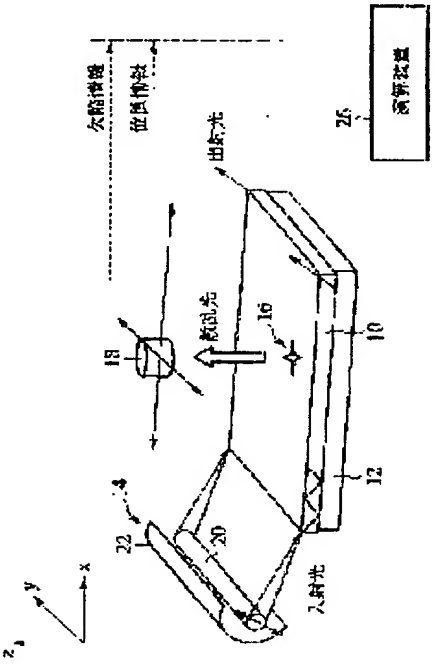
(54) METHOD AND DEVICE FOR DETECTING DEFECT IN SUBSTRATE



(57)Abstract:
PROBLEM TO BE SOLVED: To provide a method and a device for detecting a defect in a substrate, allowing the rapid detection of the defect in the optically transparent substrate such as a semiconductor substrate or a glass substrate in a wide inspection object region.
SOLUTION: Light is caused to enter the measured substrate so as to be multiple-reflected inside the measured substrate 10. Scattered light generated by the reflection of the light propagated inside the measured substrate 10, by the defect 16 on the surface or interior of the measured substrate 10 is detected, and the defect 16 in the measured substrate 10 is detected on the basis of the detected scattered light.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the defective detection approach and equipment of a substrate which detect the defect of a transparent substrate optically [a semi-conductor substrate, a glass substrate, etc.].
[0002]
[Description of the Prior Art] Surface blemishes and minute defects, such as a semi-conductor substrate and a glass substrate used for a liquid crystal display, do effect important for those quality. For example, in the semiconductor wafer, the defect might be introduced at the time of the single crystal growth, and the defect might occur by heat treatment required for device production. Moreover, the defect called a scratch might occur at the process of chemical mechanical polishing of those front faces. Therefore, in order to fully guarantee the yield of a semiconductor device, distribution of a blemish or a minute defect, transition of generating accompanying advance of the production process of size and a semiconductor device, etc. needed to be inspected, and the production process of a semiconductor device needed to be managed.
[0003] The following was used as a technique of detecting the blemish and the minute defect on the above front faces of a substrate until now.
[0004] First, laser scan mold defective test equipment, an optical acoustic-imaging method, etc. are learned as what uses a laser beam as a probe.
[0005] In laser scan mold defective test equipment, a measurement-board-ed front face is irradiated scanning a laser beam with a diameter of several microns with a rotation polyhedron, and the blemish and minute defect of a measurement-board-ed front face are detected by detecting the reflected light or the scattered light at this time. This equipment can be optically used also to the opaque matter.

[0006] By the optical acoustic-imaging method, it converges on a measurement-board-ed front face, a laser beam is irradiated, and a measurement board-ed detects the heat which absorbs light and is generated as pressure variation (acoustic wave). Since it usually becomes irregular on the frequency of several MHz from 10Hz, pressure variation is also modulated on this frequency and laser light serves as an acoustic wave. The strength of an acoustic wave is dependent on the light absorption multiplier of a measurement board-ed, the specific heat, and thermal conductivity. These light absorption multiplier, the specific heat, and thermal conductivity show the value in which a normal part differs from the blemish and minute defect of a measurement board-ed. Therefore, a laser beam is irradiated and the blemish and minute defect of a measurement-board-ed front face can be detected by detecting the acoustic wave from a measurement board-ed by the microphone, a piezo-electric element, etc.
[0007] Moreover, various microscopes are also used for the blemish on the front face of a substrate, or detection of a minute defect, and it is ******. Nomarski differential interference microscope, an interference microscope, a scan mold probe microscope, etc. are typical.
[0008]
[Problem(s) to be Solved by the Invention] However, with the technique used for detection of the conventional defect which was mentioned above, when an extensive substrate front face was inspected, huge time amount was needed.
[0009] For example, the diameter of a laser beam which extracted the test equipment using a laser beam became detection area, and great time amount was needed for wide range inspection. On the other hand, although the visual field of each microscope becomes detection area under various microscopes, in order for information processing of the acquired image data to take great time amount, it was unsuitable for wide range inspection of a substrate.
[0010] The purpose of this invention is to offer the defective detection approach and equipment of a substrate which are a large inspection object domain and can detect the defect of a transparent substrate at a high speed optically [a semi-conductor substrate, a glass substrate, etc.].
[0011]
[Means for Solving the Problem] The above-mentioned purpose the light emitted from the light source so that it may reflect multiply inside a measurement board-ed A photodetection means to detect the scattered light produced when the optical incidence means which carries out incidence, and the light which spreads said interior of a measurement board-ed are scattered on the interior of said measurement board-ed according to the front face of said measurement board-ed, or an internal defect, It is based on the relative physical relationship of said photodetection means and said measurement board-ed, and is attained by the defective detection equipment of the substrate characterized by having a location specification means to pinpoint the location within said measurement-board-ed side of said defect.
[0012] Moreover, in the defective detection equipment of the above-mentioned substrate, said optical incidence means may be made to carry out the sweep of whenever [incident angle / of said light which carries out incidence to the interior of said measurement board-ed] within limits which light reflects multiply in the interior of said measurement board-ed.
[0013] Moreover, you may make it have further a position control means to move the relative location of said measurement board-ed and said photodetection means, in the defective detection equipment of the above-mentioned substrate.
[0014] Moreover, it sets to the defective detection equipment of the above-mentioned substrate, and you may make it said photodetection means have further a depth detection means to detect the depth of said defect in said measurement board-ed.
[0015] Moreover, after reflecting multiply said interior of a measurement board-ed, it has further the spectral-analysis machine which carries out spectral analysis of the light by which outgoing radiation is carried out, and in the defective detection equipment of the above-

mentioned substrate, based on the measurement result by said spectroscope, it may be made to measure the pollutant adhering to said measurement board-ed.
[0016] Moreover, you may make it have further a defective analysis means to analyze said defect which pinpointed the location with said location specification means, in the defective detection equipment of the above-mentioned substrate.
[0017] Moreover, the above-mentioned purpose carries out incidence of the light to said measurement board-ed, detects the scattered light produced when the light which spreads said interior of a measurement board-ed reflects according to the front face of said measurement board-ed, or an internal defect so that it may reflect multiply inside a measurement board-ed, and it is attained based on said detected scattered light by the defective detection approach of the substrate characterized by detecting said defect of said measurement board-ed.
[0018] Moreover, in the defective detection approach of the above-mentioned substrate, it may be made to carry out the sweep of whenever [incident angle / of the light which carries out incidence to the interior of said measurement board-ed] within limits which light reflects multiply in the interior of said measurement board-ed.
[0019] Moreover, in the defective detection approach of the above-mentioned substrate, it may be made to detect a defect by measuring changing the relative location of the photodetector which detects said scattered light, and said measurement board-ed over the whole abbreviation surface of said measurement board-ed.
[0020] Moreover, as for said measurement board-ed, in the defective detection approach of the above-mentioned substrate, it is desirable to have an abbreviation rectangle configuration and to carry out incidence of the light to coincidence covering the end side of said measurement board-ed.
[0021] Moreover, said measurement board-ed has the shape of an abbreviation anchor ring, and you may make it introduce light in the defective detection approach of the above-mentioned substrate from the inner circumference end face or periphery end face of said measurement board-ed.
[0022] Moreover, after reflecting multiply said interior of a measurement board-ed, spectral analysis of the light by which outgoing radiation is carried out is carried out, and in the defective detection approach of the above-mentioned substrate, it may be made to measure the pollutant adhering to said measurement board-ed.
[0023] Moreover, said measurement board-ed is inspected over the large range by the defective detection approach of the above-mentioned substrate, and it may be made to analyze about the narrow range including said defect based on the positional information of said defect specified by said defective detection approach.
[0024]
[Embodiment of the Invention] The defective detection approach and equipment of a substrate by the 1st operation gestalt of [1st operation gestalt] this invention are explained using drawing 1 and drawing 2 . Drawing 1 is the perspective view showing the configuration of the defective detection equipment of the substrate by this operation gestalt, and drawing 2 is the sectional view.
[0025] First, the configuration of the defective detection equipment of the substrate by this operation gestalt is explained using drawing 1 and drawing 2 .
[0026] On the substrate loading base 12, the measurement board 10-ed which is the object which inspects a defect is laid. The photodetector 18 which detects the light scattered on the measurement-board-ed 10 upper part according to the defect 16 of the measurement board 10-ed is arranged. Moreover, near the edge of the measurement board 10-ed, the incident light study system 14 which carries out incidence of the light to the measurement-board-ed 10 interior is arranged.
[0027] The incident light study system 14 consisted of the light sources 20 and the reflecting

mirrors 22 which emit the light from ultraviolet rays to infrared radiation, and is equipped with the incident light include-angle regulatory mechanism (not shown) which controls further whenever [incident angle / of the light which carries out incidence to the measurement-board-ed 10 interior].

[0028] The photodetector 18 is equipped with XY directional movement device 24 in which the location of the photodetector 18 to the measurement board 10-ed is changed.

[0029] The photodetector 18, XY directional movement device 24, and the display 28 that displays the result of an operation are connected to the arithmetic unit 26.

[0030] Next, actuation of the defective detection equipment of the substrate by this operation gestalt is explained.

[0031] It is reflected by the reflecting mirror 22 and the light by which outgoing radiation was carried out from the light source 20 is introduced into coincidence over one end face of the measurement board 10-ed. At this time, the include angle of the light which carries out incidence to measurement-board-ed 10 end face can be controlled by the incident light include-angle regulatory mechanism, and can carry out incidence of the light by which outgoing radiation was carried out from the light source 20 at a predetermined include angle, or can carry out the sweep of whenever [incident angle].

[0032] A photodetector 18 can detect the scattered light produced when the light which carries out outgoing radiation, i.e., the light which spreads the measurement-board-ed 10 interior, is scattered about above the measurement board 10-ed according to a defect 16. The detecting signal at this time is inputted into an arithmetic unit 26. Moreover, a photodetector 18 can move broadly according to XY directional movement device 24 in the measurement-board 10-ed top. The positional information of XY directional movement device 24 is inputted into an arithmetic unit 26 as a position signal.

[0033] The detecting signal from a photodetector 18 and the position signal from XY directional movement device 24 are combined, and an arithmetic unit 26 can analyze the location of the defect 16 of the measurement board 10-ed. The analysis result of an arithmetic unit 26 can be drawn to a display 28 as-dimensional [2] or the three-dimensions distribution image of the defect 16 of the measurement board 10-ed.

[0034] Next, the defective detection approach of the substrate by this operation gestalt is explained using drawing 2 .

[0035] First, the measurement board 10-ed is laid in the substrate loading base 12. In addition, on these specifications, a transparent substrate is called a substrate on optical targets, such as a semi-conductor substrate and a tabular glass substrate for liquid crystal displays. Moreover, transparence means optically having the wave number region which penetrates light, and it is contained not only a light region but when it has permeability also to the light of an ultraviolet region and an infrared region.

[0036] Next, incidence of the light which carried out outgoing radiation from the light source 20 of the incident light study system 14 is carried out to measurement-board-ed 10 end face. Here, the wavelength of the light which carries out outgoing radiation is chosen from the light source 20 according to the quality of the material of the measurement board 10-ed. That is, the light of the wavelength which can penetrate the quality of the material of the measurement board 10-ed is chosen from the light source 20 as a light which carries out outgoing radiation. This is because the light which carried out incidence to the measurement-board-ed 10 interior needs to reflect multiply in the measurement-board-ed 10 interior. For example, in the case of the silicon substrate which has a transparency band in an infrared region, it is made into the light which carries out outgoing radiation of the light of an infrared region from the light source 20, and, in the case of the glass substrate which has a transparency band in a light region, is made into the light which carries out outgoing radiation of the light of a visible region from the light source 20.

[0037] In case the light by which outgoing radiation was carried out to the measurement-board-ed 10 interior from the light source 20 is introduced from measurement-board-ed 10 end face, whenever [incident angle / of light] is controlled by the incident light include-angle regulatory mechanism so that light carries out incidence to the measurement-board-ed 10 interior at an angle of predetermined. That is, with the defective detection equipment of the substrate by this operation gestalt, the defect 16 on the measurement board 10-ed is detected by detecting the scattered light which reflects light multiply in the measurement-board-ed 10 interior, and is produced in the location of the defect 16 of measurement-board-ed 10 front face. Therefore, the incident light to the measurement board 10-ed needs to set up an incident angle so that it may reflect multiply inside a substrate.
[0038] The conditions in which light carries out full reflection inside a substrate can be found from a Snell's law and count of a reflection coefficient of sound energy intensity. For example, full reflection is carried out when the include angle which a silicon substrate and infrared radiation make when carrying out incidence of the infrared radiation to a silicon substrate end face is zero - 72 degrees. The place at which the miracle of infrared radiation with the include angle of this range is followed conversely, and the end face of a silicon substrate is crossed is a probe index to an infrared silicon substrate.
[0039] Moreover, the operation of the incident light include-angle regulatory mechanism of the incident light study system 14 divides roughly, and has two approaches.
[0040] The 1st approach is the approach of fixing to the predetermined value with which the conditions which mentioned above whenever [incident angle / of the incident light to the measurement-board-ed 10 interior] are filled.
[0041] This approach fixes whenever [incident angle / of the light which carries out incidence to the measurement board 10-ed] so that the total reflection angle of the light in the measurement-board-ed 10 interior may serve as a predetermined value. Since the count of reflection in the measurement-board-ed 10 interior will also change if whenever [angle-of-reflection / of the light in the measurement-board-ed 10 interior] changes, a possibility that dispersion may arise is in sensitometry. Therefore, fixing whenever [incident angle / of the light from the light source] to a predetermined value has an advantage, such as pressing down dispersion in the sensitometry between substrates.
[0042] However, if whenever [incident angle / of the light from the light source 20] is fixed, light will carry out incidence and the field which carries out internal reflection, and the field where incidence of the light is not carried out and internal reflection does not happen will exist. For this reason, what dispersion of light does not take place and is not detected in the location where the defect 16 exists on the measurement board 10-ed will come out.
[0043] Then, within limits in which a multiple echo occurs the light emitted from the light source 20 in the measurement-board-ed 10 interior, the 2nd approach is carrying out incidence to the measurement board 10-ed, carrying out the sweep of the incident angle by the incident light include-angle regulatory mechanism, and aims at improvement in detection sensitivity. By changing continuously, the total reflection field on an optical path continues whenever [incident angle]. Thereby, the defect 16 of measurement-board-ed 10 front face is completely detectable by high sensitivity.
[0044] The light which carried out incidence to the measurement-board-ed 10 interior by the conditions and approach which were mentioned above is spread reflecting multiply the measurement-board-ed 10 interior. this time -- measurement-board-ed 10 front face and the interior -- a defect 16 -- existing -- if -- that defect 16 -- light -- reflecting -- -ed -- it stops fulfilling the total reflection conditions inside measurement-board 10, and outgoing radiation of a part of light is carried out on the measurement board 10-ed. Therefore, the defect 16 of the measurement board 10-ed is detectable by detecting the light by which outgoing radiation was carried out in this way on the measurement board 10-ed with a photodetector 18.

[0045] Subsequently, the detecting signal from a photodetector 18 is inputted into an arithmetic unit 26, and an arithmetic unit 26 is combined with the position signal from XY directional movement device 24, and analyzes the location of the defect of measurement-board-ed 10 front face. An analysis result can be displayed on a display 28 as-dimensional [2] or the three-dimensions distribution image of the defect 16 of measurement-board-ed 10 front face.
[0046] Subsequently, it is possible for the measurement board 10-ed to reach far and wide, and to detect a defect by moving the location of the photodetector 18 to the measurement board 10-ed, repeating the defective detection mentioned above in each migration location, and performing it according to XY directional movement device 24. In this way, defective detection of a substrate is ended.
[0047] Thus, since according to this operation gestalt a defect is detected by detecting the light scattered about according to the defect on the front face of a substrate while reflecting multiply inside a substrate, it is a large inspection object domain, and the defect of a substrate can be detected at a high speed, and the throughput of the inspection process of a defect improves sharply.
[0048] Moreover, when infrared radiation is used as incident light to the measurement board 10-ed, it is possible to inspect contamination by the organic substance of measurement-board-ed 10 front face by reflecting multiply the measurement-board-ed 10 interior, and introducing and carrying out the infrared fourier spectrum of the light which carries out outgoing radiation to a spectroscope from an end face opposite to the end face which carried out incidence of the light. The measuring method of the surface state by the infrared multiple echo is described by the Japanese-Patent-Application-No. No. 95853 [11 to] specification by the same applicant.
[0049] In addition, in addition to the configuration mentioned above, a photomultiplier etc. may be attached in the photodetector 18 preceding paragraph as an optical amplification function. It enables this to detect the feebleer scattered light from measurement-board-ed 10 front face. Therefore, it becomes possible to detect more the defect 16 on the measurement board 10-ed by high sensitivity.
[0050] In addition, with the above-mentioned operation gestalt, although the photodetector 18 was moving according to XY directional movement device 24 in the measurement-board 10-ed top, the substrate loading base 12 may move to a photodetector 18 conversely.
[0051] The defective detection approach and equipment of a substrate by the 2nd operation gestalt of [2nd operation gestalt] this invention are explained using drawing 3 and drawing 4 . Drawing 3 is the perspective view showing the configuration of the defective detection equipment of the substrate by the operation gestalt of this invention, and drawing 4 is the sectional view. in addition, the sign same to the same component as the defective detection approach of a substrate and equipment by the 1st operation gestalt -- giving -- explanation -- an abbreviation -- or it is made simple.
[0052] As for this operation gestalt, not only the defect on the front face of a substrate but the defect inside a substrate makes detectable the defective detection equipment of the substrate by the 1st operation gestalt.
[0053] As shown in drawing 3 and drawing 4 , the fundamental configuration of the defective detection equipment of the substrate by this operation gestalt is the same as that of the defective detection equipment of the substrate by the 1st operation gestalt.
[0054] The defective detection equipment of the substrate by this operation gestalt has the description in the depth of focus accommodation optical system 30 being attached in the photodetector 18 preceding paragraph. That is, it becomes detectable [the scattered light of not only the scattered light from measurement-board-ed 10 front face but the measurement-board-ed 10 interior] by changing the depth of focus of the depth of focus accommodation optical system 30. Therefore, it becomes possible to detect the defect which exists not only in

the defect 16 of measurement-board-ed 19 front face but in the measurement-board-ed 10 interior.
[0055] At this time, the depth of the location of the defect of the measurement-board-ed 10 interior can be determined from change of the depth of focus. Therefore, it is possible to obtain the spatial distribution image of the defect of the measurement-board-ed 10 interior.
[0056] Thus, since according to this operation gestalt a defect is detected by detecting the light scattered about according to the defect of a substrate while reflecting multiply inside a measurement board-ed, it is a large inspection object domain, and the defect of a substrate can be detected at a high speed, and the throughput of the inspection process of a defect improves sharply.
[0057] The defective detection approach and equipment of a substrate by the 3rd operation gestalt of [3rd operation gestalt] this invention are explained using drawing 5 and drawing 6 . Drawing 5 is the perspective view showing the configuration of the defective detection equipment of the substrate by this operation gestalt, and drawing 6 is the sectional view. in addition, the sign same to the same component as the defective detection approach of a substrate and equipment by the 1st operation gestalt -- giving -- explanation -- an abbreviation -- or it is made simple.
[0058] This operation gestalt applies the defective detection approach and equipment of a substrate by the 1st operation gestalt or the 2nd operation gestalt to the doughnut-like substrate used for a hard disk, an optical disk, etc. In addition, on these specifications, it is a circle configuration and the configuration by which the inner circumference part is removed is called "the shape of a doughnut "
[0059] First, the configuration of the defective detection equipment of the substrate by this operation gestalt is explained using drawing 5 and drawing 6 .
[0060] On the substrate loading base 12, the measurement board 32-ed [doughnut-like] which is the object which inspects a defect is laid. The photodetector 18 which detects the light scattered on the measurement-board-ed [doughnut-like] 32 upper part according to the defect 16 of the measurement board 32-ed [doughnut-like] is arranged. Moreover, near the inner circumference end face of the measurement board 32-ed [doughnut-like], the incident light study system 14 which carries out incidence of the light to the measurement-board-ed [doughnut-like] 32 interior is arranged.
[0061] The substrate loading base 12 is equipped with the rolling mechanism (not shown) turning around the laid measurement board 32-ed [doughnut-like].
[0062] The incident light study system 14 consisted of the light sources 20 and the reflecting mirrors 22 which emit the light from ultraviolet rays to infrared radiation, and is equipped with the incident light include-angle regulatory mechanism (not shown) which controls further whenever [incident angle / of the light which carries out incidence to the measurement-board-ed / doughnut-like / 32 interior].
[0063] The photodetector 18 is equipped with X directional movement device 34 in which the location of the photodetector 18 to the measurement board 10-ed is changed.
[0064] The substrate loading base 12, the photodetector 18, X directional movement device 34, and the display 28 that displays the result of an operation are connected to the arithmetic unit 26.
[0065] Next, actuation of the defective detection equipment of the substrate by this operation gestalt is explained.
[0066] It is reflected by the reflecting mirror 22 and the light by which outgoing radiation was carried out from the light source 20 is introduced into the inner circumference end face of the measurement board 32-ed [doughnut-like]. At this time, it is possible to control the include angle of the light which carries out incidence to measurement-board-ed [doughnut-like] 32 end face by the incident light include-angle regulatory mechanism, and incidence of the light

by which outgoing radiation was carried out from the light source 20 can be carried out at a predetermined include angle, or the sweep of whenever [incident angle] can be carried out.
[0067] A photodetector 18 can detect the scattered light produced when scattered about according to the defect 16 of **** which spreads the measurement-board-ed [doughnut-like] 32 interior. The detecting signal at this time is inputted into an arithmetic unit 26. Moreover, a photodetector 18 is perpendicularly movable to the hand of cut of the measurement board 32-ed [doughnut-like] with X directional movement device 34. The positional information of X directional movement device 34 is inputted into an arithmetic unit 26 as a position signal.
[0068] The measurement board 32-ed [doughnut-like] can be rotated by the rolling mechanism of the substrate loading base 12, and the positional information at the time of rotation of the measurement board 32-ed [doughnut-like] is inputted into an arithmetic unit 26 as a position signal.
[0069] The detecting signal from a photodetector 18, the positional information from a rolling mechanism, and the position signal from X directional movement device 34 are combined, and an arithmetic unit 26 can analyze the location of the defect 16 of the measurement board 32-ed [doughnut-like]. The analysis result of an arithmetic unit 26 can be drawn to a display 28 as-dimensional [2] or the three-dimensions distribution image of the defect 16 of the measurement board 32-ed [doughnut-like].
[0070] Next, the defective detection approach of the substrate by this operation gestalt is explained using drawing 6 .
[0071] First, the measurement board 32-ed [doughnut-like] is laid in the substrate loading base 12
[0072] Next, the measurement board 32-ed [doughnut-like] is rotated by the rolling mechanism of the substrate loading base 12 centering on the central point of the measurement board 32-ed [doughnut-like].
[0073] Next, the light which carried out outgoing radiation from the light source 20 of the incident light study system 14 is introduced into the inner circumference end face of the measurement board 32-ed [doughnut-like]. The wavelength of the light which carries out outgoing radiation is chosen from the light source 20 like the 1st operation gestalt according to the quality of the material of the measurement board 32-ed [doughnut-like].
[0074] The sweep of the light which carries out outgoing radiation from the light source 20 is carried out within the limits of the incident angle which introduces like the 1st operation gestalt by the incident angle of the conditions reflected multiply inside a substrate, and fixes at the include angle by the incident light include-angle regulatory mechanism of the incident light study system 14, or is reflected multiply.
[0075] The light which carried out incidence to the measurement-board-ed [doughnut-like] 32 interior on the conditions mentioned above is spread reflecting multiply the measurement-board-ed [doughnut-like] 32 revolving interior. If a defect 16 exists in measurement-board-ed [doughnut-like] 32 front face or the interior at this time, it will stop fulfilling the total reflection conditions in the interior of a substrate, and outgoing radiation of a part of light will be carried out on the measurement board 32-ed [doughnut-like]. Therefore, the defect 16 of the measurement board 32-ed [doughnut-like] is detectable by detecting the light by which outgoing radiation was carried out in this way on the measurement board 32-ed [doughnut-like] with a photodetector 18.
[0076] It is possible to detect the defect of all the fields of the measurement board 32-ed [doughnut-like] by performing defective detection which changed and mentioned the location of a photodetector 18 above according to X directional movement device 34 ranging from measurement-board-ed [doughnut-like] 32 revolving inner circumference to a periphery.
[0077] The detecting signal from a photodetector 18 is inputted into an arithmetic unit 26. An arithmetic unit 26 combines the detecting signal from a photodetector 18, the position signal

from the rolling mechanism of the substrate loading base 12, and the position signal from X directional movement device 34, and analyzes the location of the defect of measurement-board-ed [doughnut-like] 32 front face. An analysis result can be displayed on a display 28 as-dimensional [2] or the three-dimensions distribution image of the defect 16 of measurement-board-ed [doughnut-like] 32 front face. In this way, defective detection of a substrate is ended.

[0078] Thus, since according to this operation gestalt a defect is detected by detecting the light scattered about according to the defect on the front face of a substrate while reflecting multiply inside a substrate, it is a large inspection object domain, and the defect of a doughnut-like substrate front face can be detected at a high speed, and the throughput of the inspection process of a defect improves sharply.

[0079] In addition, with the above-mentioned operation gestalt, although light was introduced into the measurement-board-ed [doughnut-like] 32 interior by the incident light study system 14 from the measurement-board-ed [doughnut-like] 32 inner-circumference end face, incidence of the light may be carried out from a periphery end face.

[0080] Not only the operation gestalt of [deformation implementation gestalt] this invention but various deformation is possible.

[0081] For example, the wide angle lens for observing the optical system which changes the area which can observe the measurement board 10-ed to the photodetector 18 preceding paragraph, for example, a large field, the micro lens for observing a little narrow field, etc. may be attached.

[0082] Moreover, with the above-mentioned operation gestalt, in any case, although the defective detection equipment of a substrate was used independently, you may use combining the various microtechnique which has a high resolution, for example, an approaching space optical application prober, the atomic force microscope which is a kind of a scan mold probe microscope. That is, the defective detection approach of a substrate may be made into the preliminary detecting method (screening procedure), and you may inspect still more nearly spatially a field with the defect detected by this microscopically with the analysis method of a high resolution. Thereby, the detailed analysis about the configuration and the fine structure of a defect on the front face of a substrate is attained. furthermore, microtechnique, such as an atomic force microscope, -- if independent, the identification of the location of a defect made applicable [in the difficult large inspection zone] to observation becomes easy, and working efficiency improves sharply.

[0083] In this case, first, the defective detection equipment of a substrate detects the defect on the front face of a substrate, and the location of the defect in a substrate front face is identified. It continues, the test section of the combined microtechnique is introduced into the location of a defect based on measurement of the defective detection equipment of a substrate, and high resolution observation of a defect is performed.

[0084] Moreover, the defective detection equipment of a substrate may be combined with the microtechnique which acquires the concavo-convex information on the front face of a substrate, for example, an atomic force microscope etc. By the microtechnique which acquires concavo-convex information, the defect on a substrate front face and the particle adhering to a substrate front face can be identified clearly, and the defective detection with a more high precision is attained.

[0085]

[Effect of the Invention] According to this invention the above passage, so that it may reflect multiply inside a measurement board-ed Since incidence of the light is carried out to a measurement board-ed, the scattered light produced when the light which spreads the interior of a measurement board-ed reflects according to the front face of a measurement board-ed or an internal defect is detected and said defect of a measurement board-ed is detected based on

the detected scattered light Optically [a semi-conductor substrate, a glass substrate, etc.], it is a large inspection object domain, and the defect of a transparent substrate can be detected at a high speed.

CLAIMS

[Claim(s)]

[Claim 1] The optical incidence means which carries out incidence of the light emitted from the light source to the interior of said measurement board-ed so that it may reflect multiply inside a measurement board-ed, A photodetection means to detect the scattered light produced when the light which spreads said interior of a measurement board-ed is scattered about according to the front face of said measurement board-ed, or an internal defect, Defective detection equipment of the substrate characterized by having a location specification means for it to be based on the relative physical relationship of said photodetection means and said measurement board-ed, and to pinpoint the location within said measurement-board-ed side of said defect.

[Claim 2] For said optical incidence means, light is defective detection equipment of the substrate characterized by carrying out the sweep of whenever [incident angle / of the light which carries out incidence to the interior of said measurement board-ed within limits reflected / in / on the defective detection equipment of a substrate according to claim 1, and / the interior of said measurement board-ed / multiply].

[Claim 3] Defective detection equipment of the substrate characterized by having further a position control means to move the relative location of said measurement board-ed and said photodetection means, in the defective detection equipment of a substrate according to claim 1 or 2.

[Claim 4] It is defective detection equipment of the substrate characterized by having further a depth detection means to detect the depth of said defect [it sets to the defective detection equipment of a substrate given in claim 1 thru/or any 1 term of 3, and / means / said / photodetection] in said measurement board-ed.

[Claim 5] Defective detection equipment of the substrate characterized by measuring the pollutant which had further the spectral-analysis machine which carries out spectral analysis of the light by which outgoing radiation is carried out after reflecting multiply said interior of a measurement board-ed on claim 1 thru/or any 1 term of 4 in the defective detection equipment of the substrate of a publication, and has adhered to said measurement board-ed based on the measurement result by said spectroscope.

[Claim 6] Defective detection equipment of the substrate characterized by having further a defective analysis means to analyze said defect which pinpointed the location in claim 1 thru/or any 1 term of 5 with said location specification means in the defective detection equipment of the substrate of a publication.

[Claim 7] The defective detection approach of the substrate which carries out incidence of the light to said measurement board-ed, detects the scattered light produced when the light which spreads said interior of a measurement board-ed reflects according to the front face of said measurement board-ed, or an internal defect, and is characterized by detecting said defect of said measurement board-ed based on said detected scattered light so that it may reflect multiply inside a measurement board-ed.

[Claim 8] The defective detection approach of the substrate characterized by carrying out the sweep of whenever [incident angle / of the light which carries out incidence to the interior of said measurement board-ed] in the defective detection approach of a substrate according to claim 7 within limits which light reflects multiply in the interior of said measurement board-

ed.
[Claim 9] The defective detection approach of the substrate characterized by detecting a defect over the whole abbreviation surface of said measurement board-ed by measuring changing the relative location of the photodetector which detects said scattered light, and said measurement board-ed in the defective detection approach of a substrate according to claim 7 or 8.
[Claim 10] It is the defective detection approach of the substrate characterized by for said measurement board-ed having an abbreviation rectangle configuration in the defective detection approach of a substrate given in claim 7 thru/or any 1 term of 9, and carrying out incidence of the light to coincidence covering the end side of said measurement board-ed.
[Claim 11] It is the defective detection approach of the substrate characterized by for said measurement board-ed having the shape of an abbreviation anchor ring in the defective detection approach of a substrate given in claim 7 thru/or any 1 term of 10, and introducing light from the inner circumference end face or periphery end face of said measurement board-ed.
[Claim 12] The defective detection approach of the substrate which carries out spectral analysis of the light by which outgoing radiation is carried out after reflecting multiply said interior of a measurement board-ed on claim 7 thru/or any 1 term of 11 in the defective detection approach of the substrate a publication, and is characterized by measuring the pollutant adhering to said measurement board-ed.
[Claim 13] Defective analytical method of the substrate characterized by analyzing about the narrow range including said defect based on the positional information of claim 7 thru/or said defect of 12 which inspected [someday] said measurement board-ed over the large range by the defective detection approach of the substrate a publication in the 1st term, and was specified by said defective detection approach.